

A detailed 3D cutaway diagram of a particle accelerator, likely the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory. The diagram shows the complex arrangement of superconducting magnets, beam pipes, and support structures. The central beam pipe is highlighted in green, surrounded by various colored components like red, blue, and yellow magnets. The entire structure is housed within a large, grey, industrial-looking building.

Brief Simulation Updates

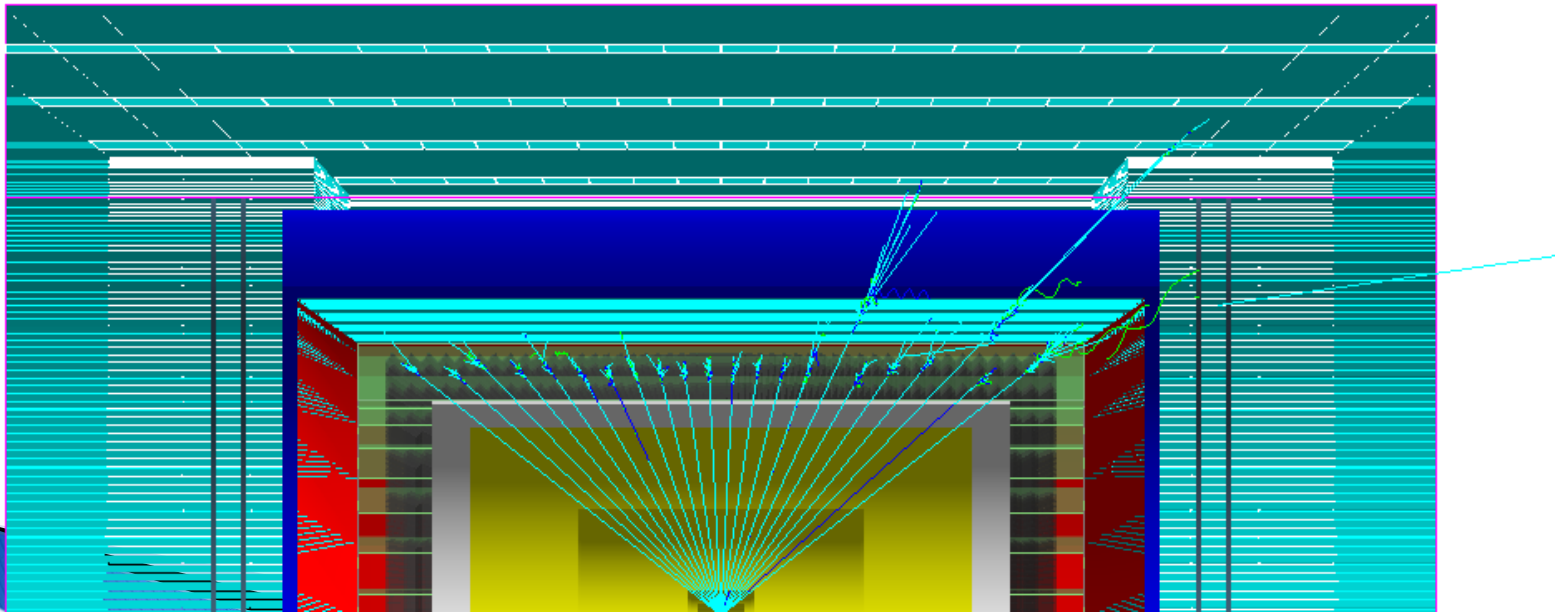
Jin Huang (BNL)

From last meetings:

SPACAL design implementation in Geant4

- ▶ Enabled with new branch 2DSpacal:
 - In nightly build, but not used by default
 - <https://github.com/sPHENIX-Collaboration/macros/pull/2>
 - <https://github.com/sPHENIX-Collaboration/coresoftware/pull/19>
 - Activated with this flag in Fun4All_sPHENIX.C

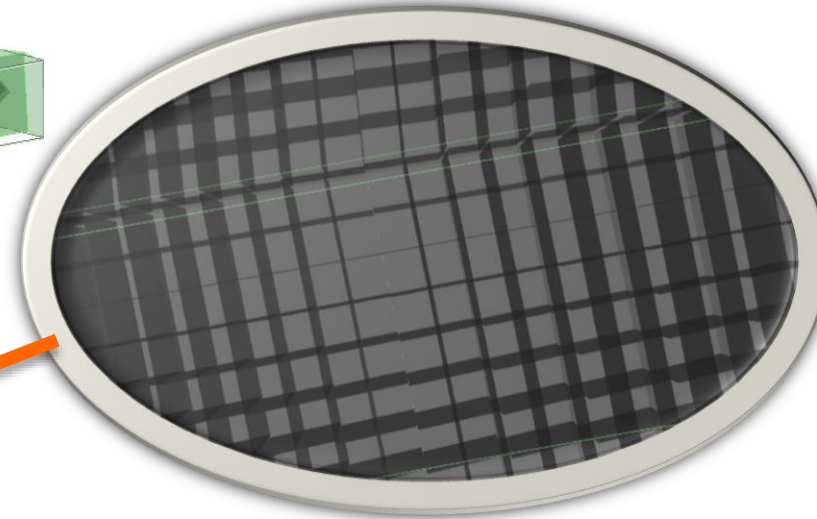
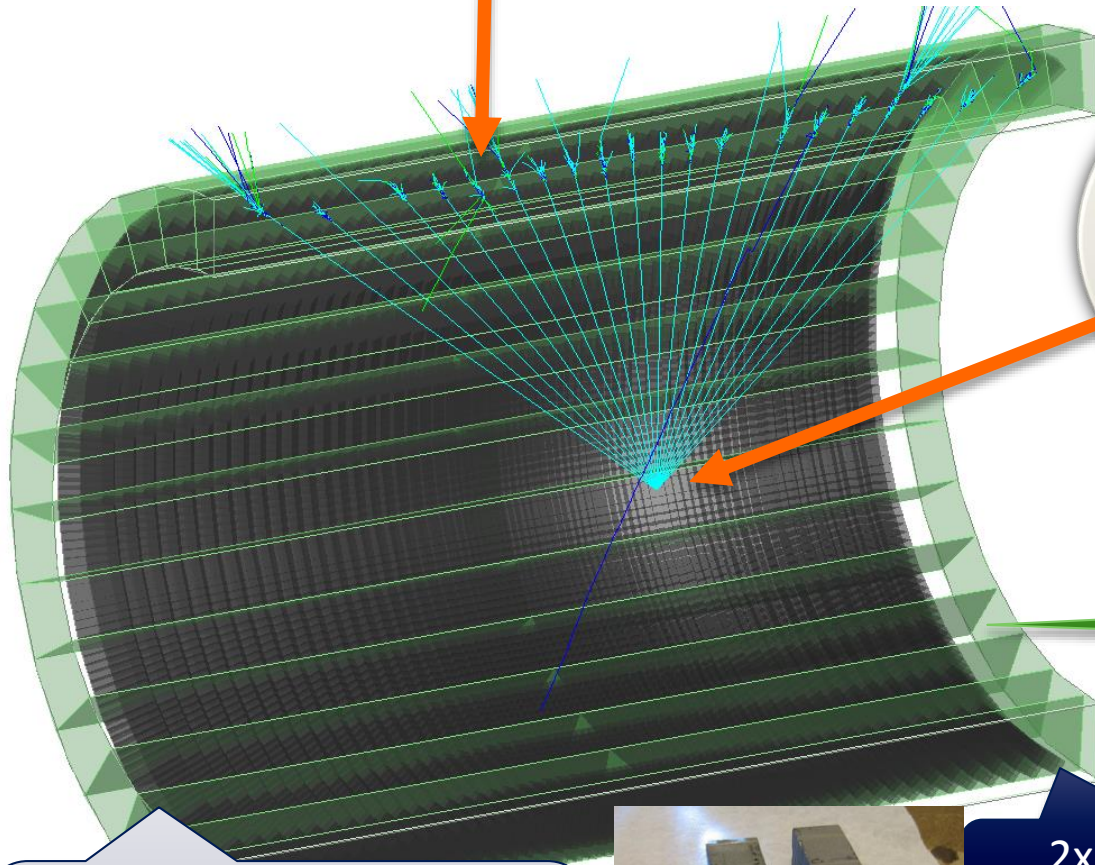
```
Cemc_spacal_configuration =  
PHG4CylinderGeom_Spacalv1::k2DProjectiveSpacal;
```





48 2x8-tower super modules

Towers project towards IP



Stainless steel SS310
Support box

Gap between modules are also implemented

- 300um tolerance outside super modules skins
- ~2mil between SPACAL and SS skin
- ~2mil between SPACAL modules



2x2 2D tapered
SPACAL modules



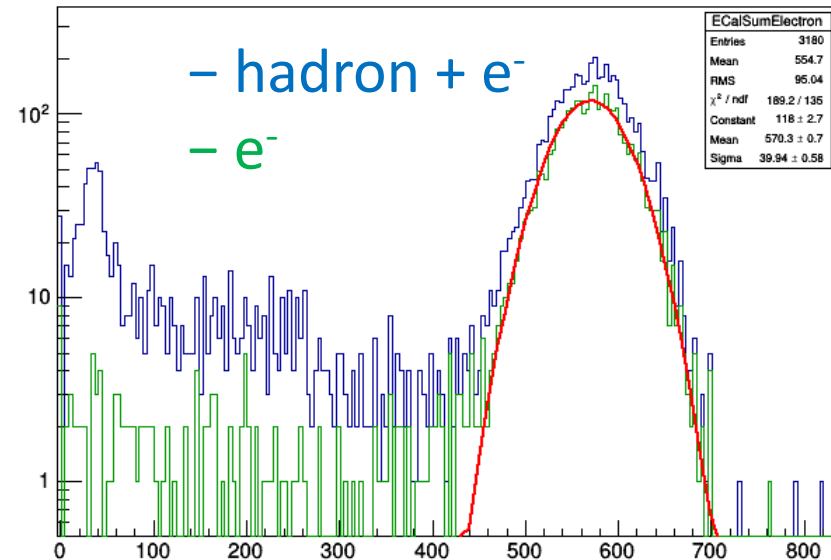
Recent updates

- ▶ Chris produced first few test productions:
 - /gpfs02/phenix/prod/sPHENIX/preCDR/pro.1-beta.2/spacal1d
 - /gpfs02/phenix/prod/sPHENIX/preCDR/pro.1-beta.2/spacal2d
- ▶ Implementation of analyzing Geant4 data in tower structures as built:
 - Tag hits in SPACAL output with sector/tower/fiber IDs.
 - Add a cell builder to group hit in each 10M SPACAL fiber separately in each cell (which allow us to implement fiber-fiber light collection eff. when needed)
 - Update tower builder to take SPACAL cells and collection light yield from each cell.
- ▶ Submitted to use in production:
<https://github.com/sPHENIX-Collaboration/coresoftware/pull/29>

Test beam comparison 1

- ▶ One of the long last concern is lack of beam test calibration for our simulation
- ▶ Obtained eRD1 2014 beam test geometry and data with many help from Oleg Tsai, Alex Kiselev and Craig Woody
- ▶ Implemented in Geant4

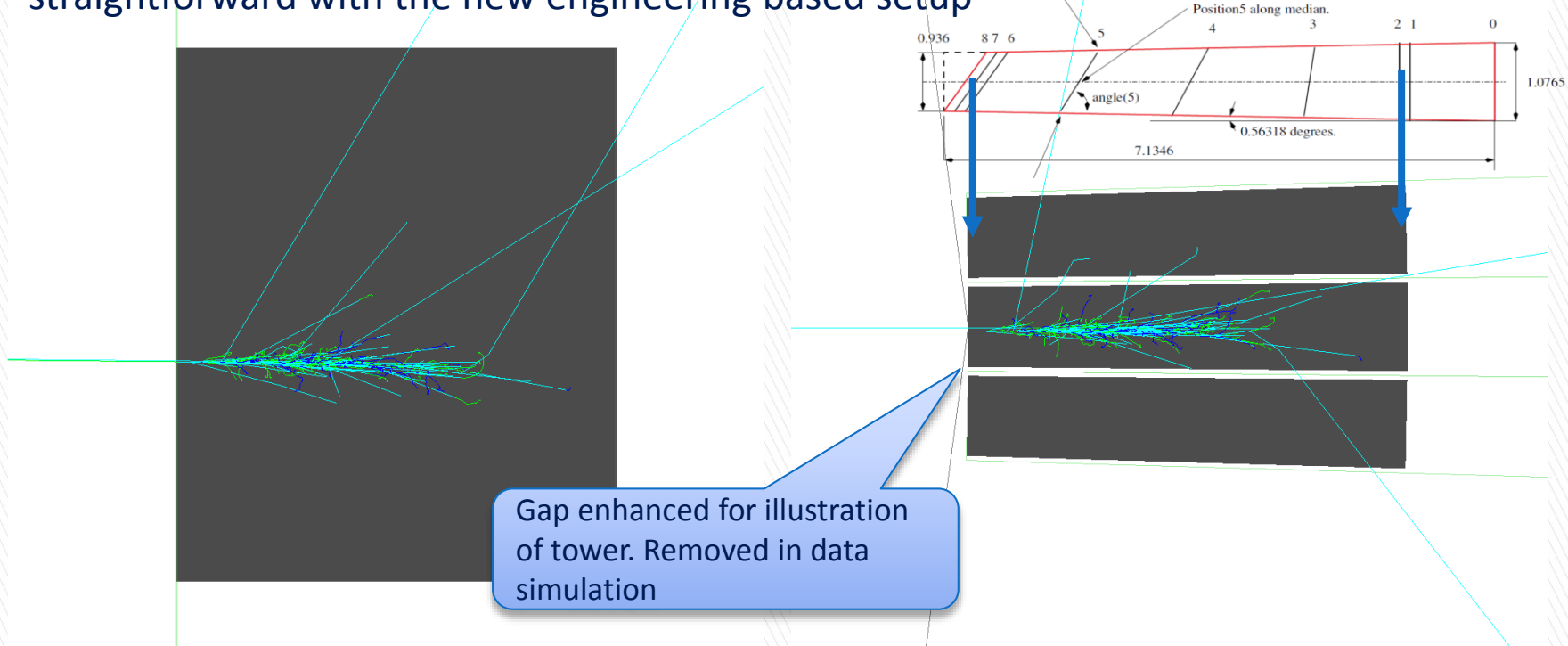
SPACAL prototypes in 2014 Fermilab beam test



Courtesy : O. Tsai (UCLA)

Test beam comparison 2: 8 GeV electron shower in Geant4

Implementation in Geant4 relatively
straightforward with the new engineering based setup

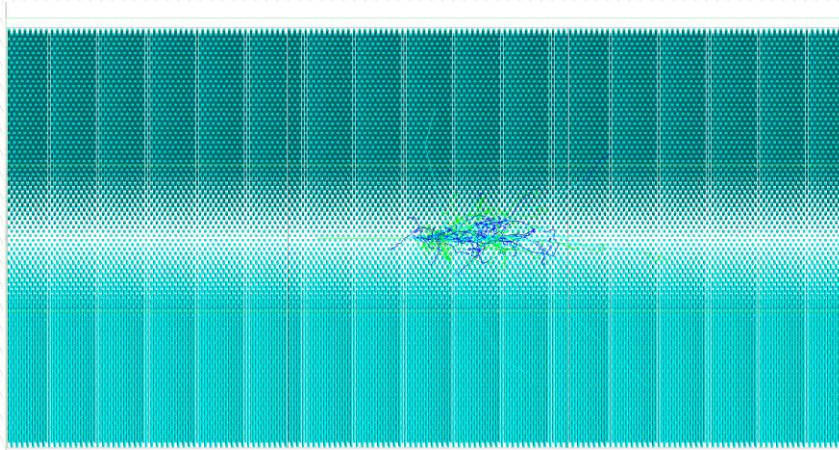


Side view (non-tapered side)
~ = Z vs R view

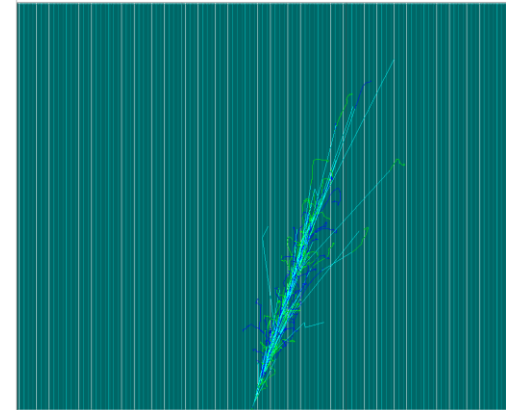
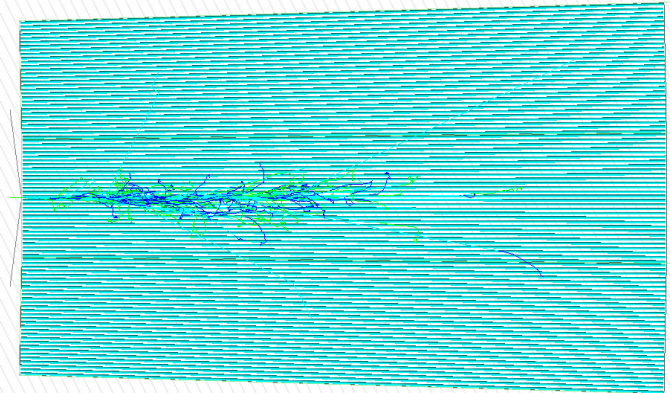
Side view (tapered side)
= beam axis view

Test beam comparison 3:

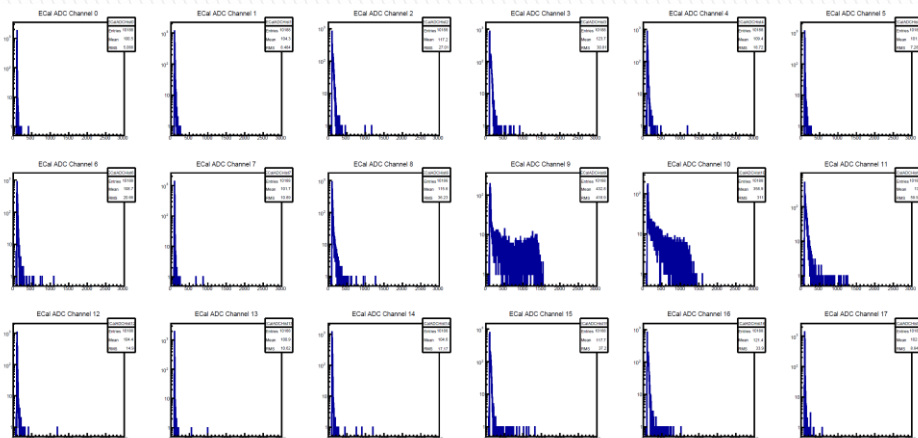
More detailed views of fiber matrix



Particle view
(half cm front Al cover not shown)



Side views
(17 degree indenting as in test beam)

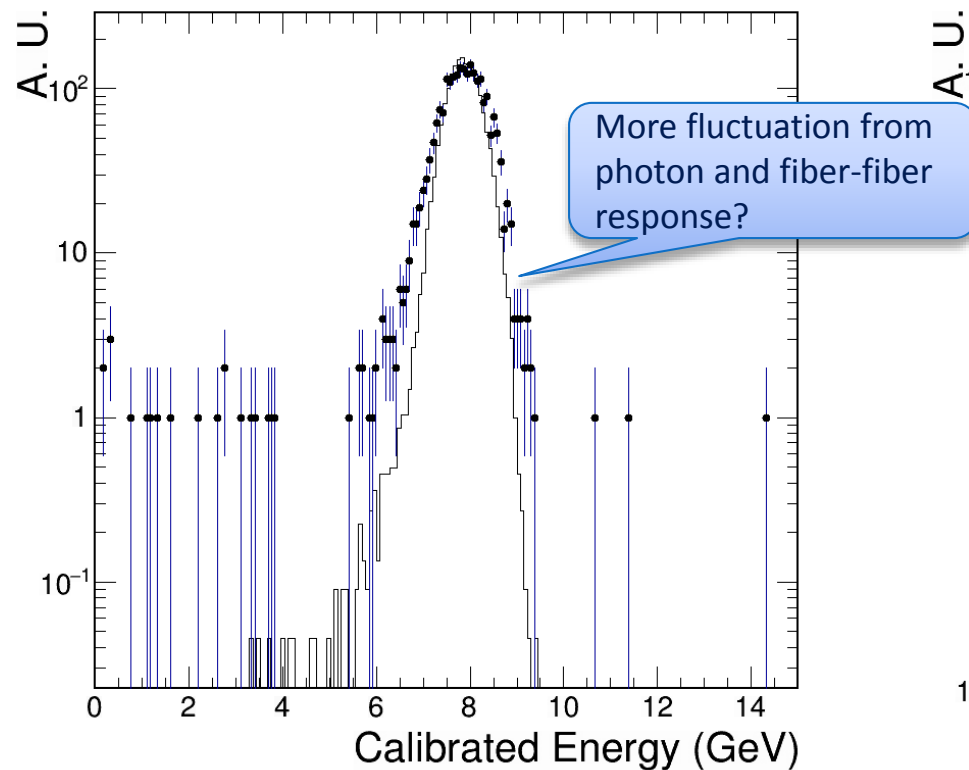


Beam test data

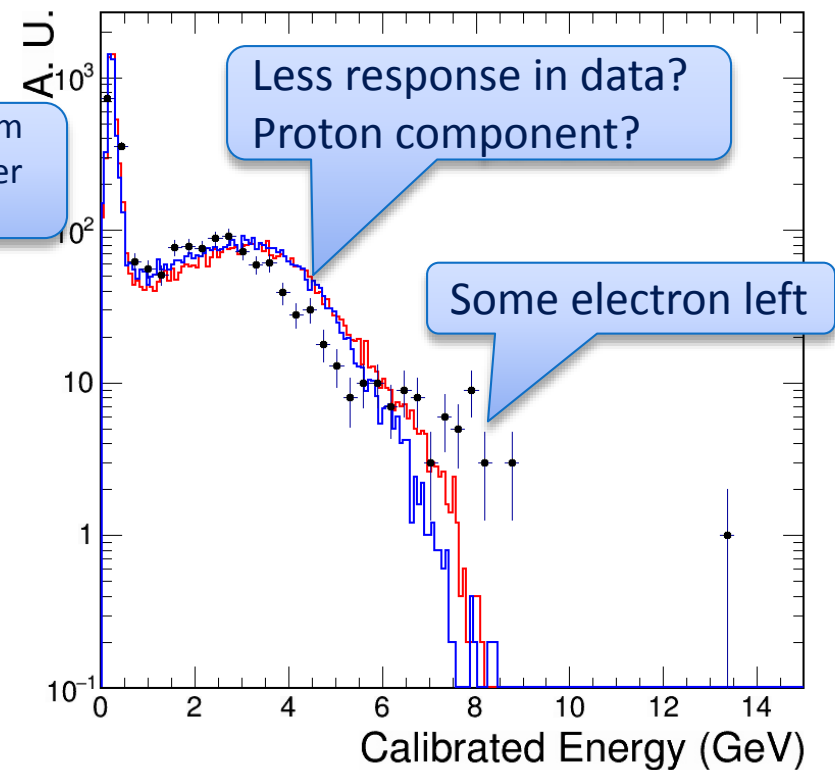
Test beam comparison 4:

8 GeV electron shower in Geant4 VS data

Electron Sim (line) VS data (point)



Pion- (red) K- (blue) Sim VS data



Full Geant4 sim QGSP_BERT_HP + light yield model (Geant4 default Birk)
Not yet applied: SiPM noise, photon fluctuation, fiber/fiber response

Photon analysis and Clusterizer choice

- ▶ Discussed possible photon Clusterizer with Stefan Bathe and Megan Connors
- ▶ Fast pre-CDR solution for photon performance in HI
 - Trying Sasha's PHENIX clusterizer
 - Ideal clustering (group tower around truth photon track)
 - Try `FastJet` with $R = \text{Mollie radius}$?
- ▶ Long term, construct an official package?
 - CMS island algorithm (Thanks to Stefan and Yen-Jie Lee (MIT)):
https://cds.cern.ch/record/687345/files/note01_034.pdf
 - Alice algorithm
 - General purpose package?
 - More volunteers?

Pre-CDR plots

- ▶ Single particle (e/mu/pi/p/gamma/pi0)
 - Line shapes [Jin] <- need to finish test beam setup
 - Linearity [Jin] <- need new production with towerings
 - Energy resolution [Jin] <- need new production with towerings
 - Sampling fraction [Jin] <- ready to produce plot with test production
 - Dynamic range [Jin] <- need new production with towerings
- ▶ Au+Au HIJING embedded
 - Underlying event energy and fluctuation [Jin]
<- need new production with towerings
 - Rejection vs efficiency for electrons [Jin]
<- need new production, verify track proj. tools
 - Photon resolution [Stefan and Megan]
<- need new production, decide the clusterizer
- ▶ EM energy trigger performance
 - Turn-on curve [Jin] <- need new production, improve last tools